Mansoura University
Faculty of Engineering
Level 400 Students.
Biomedical Engineering Program.

Final-Term Exam.

Subject: Digital Control Systems.
Course Code: CSE 494.
Date: 15/1/2020.
Time allowed: 2 Hours.

Assume any missing data....The exam is three questions. *Books & notes are not allowed.

Attempt the following questions: Max. Marks (50)

Question 1: (18marks)

(1-a) Derive the pulse T.F. for a First Order Hold having a sampling period T=0.25 sec. then, show how it acts as a low-pass filter through frequency response analysis *(10marks)*

(1-b) Solve the following difference equation: *(5marks)*

$C(k+2) + 6C(k+1) + 8C(k) = 3u(k)$ Given that: $C(0) = 0, C(1) = 2.$

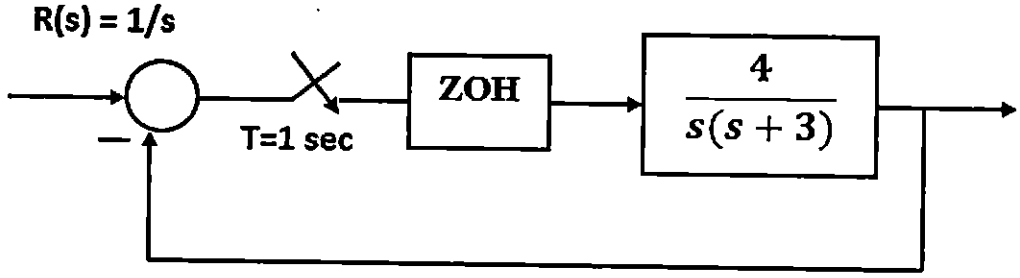
Then, sketch: C (k), for K=0, 1, 2... 5.

(1-c) Plot the following poles on Z-plane: $S_{1,2} = -3 \pm j4$, $S_{3,4} = 4 \pm j2$, where T=0.2 sec. *(3marks)*

Question 2: (15marks)

(2-a) For $C(Z) = \frac{0.36Z}{(Z-1)(Z-0.456)}$ find the final value of C(k). *(3marks)*

(2-b) Derive the pulse transfer function for the system shown in figure below: *(12marks)*



Then, Find:

1- Damping ratio ζ.
2- Max .Over-shoot (M_p)
3- Settling time for 2% error.

If the samplers & the ZOH were removed, compare the dynamic characteristics of the *discrete* system & the *continuous* system.

Question 3: (22marks)

(3-a) Given $Q(z) = z^4 - 2z^3 + 1.5z^2 - 0.1z - 0.2$, apply Jury's stability test to study the stability of Q (z), does Q (z) has any roots on or outside the unit circle? *(7marks)*

(3-b) Given $Q(z) = z^2 - 0.3Az + 0.2A$, using Jury's stability test to find the range of A for stable system, critical system, and unstable system. *(7marks)*

(3-c) Using two different methods, obtain a state-space representation of the following P.T.F system. *(8marks)*

$$P.T.F = \frac{z^2 + 2z + 3}{z^2(z-1)(z+2)}$$

With my best wishes,
Dr. Mahmoud M. Saafan,
12:00 PM, Wednesday, 15th Jan. 2020.